

Machine Learning

## Understanding AI & Machine Learning

Dept. SW and Communication Engineering

Prof. Giseop Noh (kafa46@hongik.ac.kr)

# Professor Info

## ■ Name: Giseop Noh

- Email: [kafa46@hoingik.ac.kr](mailto:kafa46@hoingik.ac.kr) (backup: [kafa46@gmail.com](mailto:kafa46@gmail.com))
- Office: D402

## ■ Job Career

- ~ 2006. 12: R.O.K Airforce, Officer in Logistics
- ~ 2016. 12: Defense Acquisition Program Administration
- ~ 2018. 02: R.O.K Airforce Academy, Assistant Professor
- ~ 2025. 02: Cheongju University, Assistance Professor
- ~ Now: Hongik University, Assistance Professor



## ■ Academic Background

- R.O.K. Airforce Academy, Bachelor in Industrial Engineering
- University of Colorado Denver, Master in Computer Science
- Seoul National University, Ph.D in Computer Engineering

# About class

- **The first 10 minutes of class will be used for**
  - Check attendance,
  - PPT setup,
  - and other necessary preparations.
  
- **If there is a consecutive class after this one,**
  - I will try to finish about 5 minutes early whenever possible.
  - However, the class may still end exactly on time.
  - If necessary, please adjust your individual course schedule accordingly,
    - considering the time required to move between buildings or classrooms.

# Attendance Check

## ■ Attendance Check:

- Online attendance verification
- If necessary, offline attendance may be used.

# Grading

## ■ Grading Distribution

- A+ / A0: 20–30%B+ / B0: 30–40%C+ / C0: 20–30%D+ / D0: 10–20%
- Subject to change according to school policy (advance notice will be given if changes occur).

## ■ Grade Processing for Insufficient Attendance

- Students who do not meet the required attendance days will receive an F grade according to university regulations.

## ■ How to Receive an F Grade

- Academic misconduct (cheating, plagiarism, etc.)
- Final score below 30 points on average
- Missing more than 1/3 of total class hours
- Failure to take the midterm or final exam without a valid reason

# Excused Absence

## ■ Excused Absence Policy

- Attendance will be recognized only if a request for approval of excused absence is submitted for reasons specified in Academic Regulations Article 75
- and approved by the dean of the affiliated college.
- Academic Regulations:
  - <https://www.hongik.ac.kr/kr/introduction/regulations-book.do?mode=list&srCategoryId=110>

## ■ Excused Absence Application Procedure

- Check Eligibility
- Verify that the reason for absence qualifies under Academic Regulations Article 75.
- Prepare Documents: Complete the "Request for Approval of Excused Absence" form and gather supporting documents (e.g., medical certificate, official notice).
- Submit Application: Submit the completed form and supporting documents to the affiliated college office.
- Dean's Approval: The dean reviews and approves the request.
- Notification: Approved absences will be officially recognized, and the student will be informed of the outcome.

# Changes in Lecture Progress

- **The lecture plan may be adjusted if deemed reasonable based on student surveys or suggestions.**
  - After the midterm exam,
  - adjustments may be made based on lecture evaluation feedback, including:
    - The need for additional explanations or deeper learning
    - Adjustments to progress and assessment scope to align with other course sections
  
- **If any modifications to the lecture plan are necessary, students will be notified in advance.**

# Course overview

Week	강의 및 실습내용 Topics, Assignments, Required Studies
1	Course Orientation, ML & DL Introduction
2	PCA, SVD
3	Support Vector Machine
4	Ensemble, Bagging, RandomForest, Boosting
5	Gradient Boosting, Stacking
6	Imbalanced Data, SMOTE Algorithm
7	Performance Metric, Shap Value
8	Mid-term exam
9	Environment Setup, Pytorch Basics
10	MLP & DNN
11	CNN 1
12	CNN 2
13	RNN 1
14	RNN 2
15	Final Exam

Note:

Course schedule may change regarding the demand of Prof. or students

# Contents

- **Concept of Artificial Intelligence**
- **Development of Artificial Intelligence**
- **Basics on Machine Learning**

# Goals

- Understand the relationship among artificial intelligence, machine learning, and deep learning.
- Understand the explosive growth of artificial intelligence in terms of data, models (algorithms), and computing power.
- Understand the basic principles of machine learning, including supervised learning, unsupervised learning, and reinforcement learning.

# Concept of Artificial Intelligence

# 인공지능 개념

## ■ Artificial Intelligence, AI

- It is a technology inspired by human intelligence and serves as a key technology in the Fourth Industrial Revolution.
- Its goal is to implement systems that perceive, decide, and act like humans.

## ■ Classification of Artificial Intelligence

- Weak Artificial Intelligence: AI specialized in a specific domain (e.g., image classification in computer vision)
- Strong Artificial Intelligence: A general-purpose AI that processes diverse data and mimics human thought processes (e.g., analyzing images and providing natural language descriptions)

**인공지능**    프로그래밍을 구축하거나 인간을 모방하여 창의적으로 문제를 해결할 수 있는 기술을 의미한다.

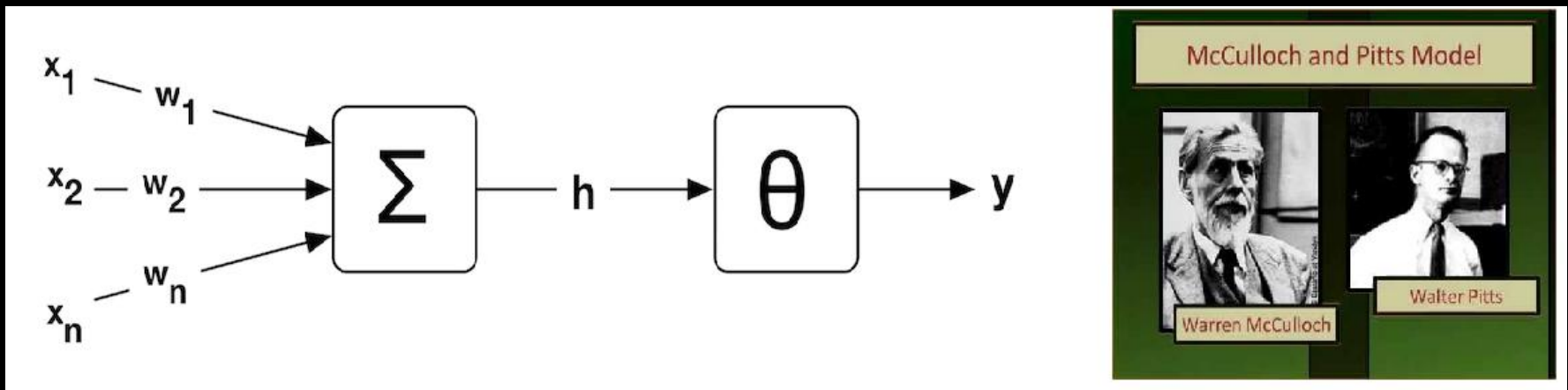
**머신러닝**    명시적인 프로그래밍이 아닌 데이터를 이용하여 스스로를 학습하는 시스템(모델)이다.  
대표적으로 회귀, 분류, 군집화 등이 있고, 지도학습, 비지도학습, 강화학습으로 구분되기도 한다.

**딥러닝**    머신러닝의 한 종류로써, 사람의 뇌 신경망을 모방한 뉴럴 네트워크를 이용하는 모델이다.

# Development of Artificial Intelligence

## ■ History of Artificial Intelligence (1/2)

- **1943:** Warren McCulloch and Walter Pitts proposed that the functioning of neurons could be analyzed using propositional logic and that neurons capable of expressing logical operations could be constructed.

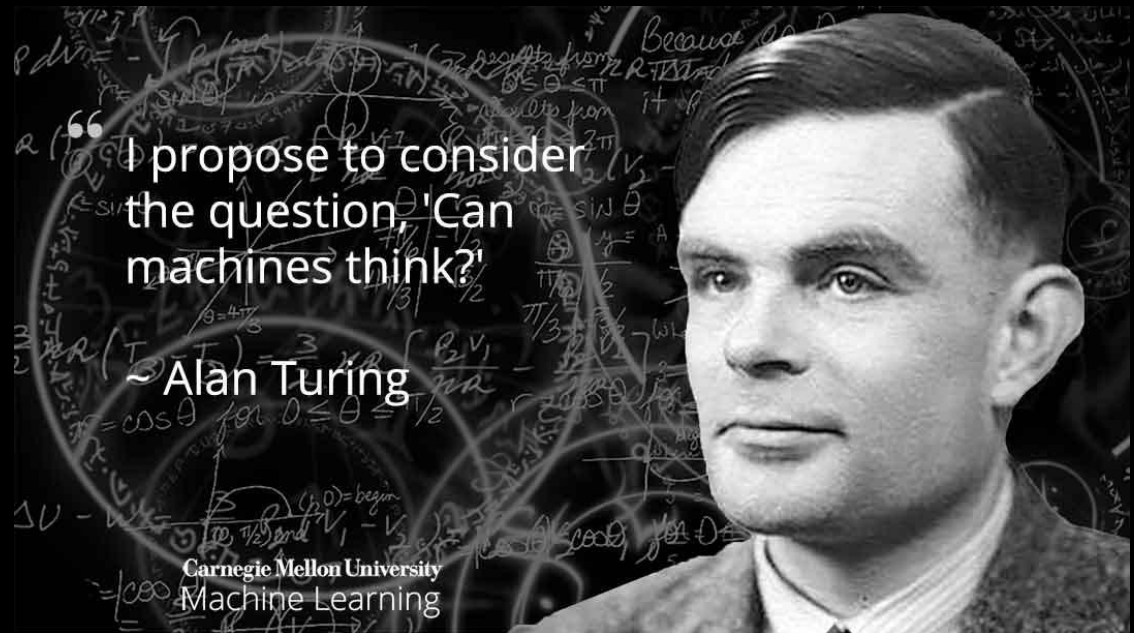
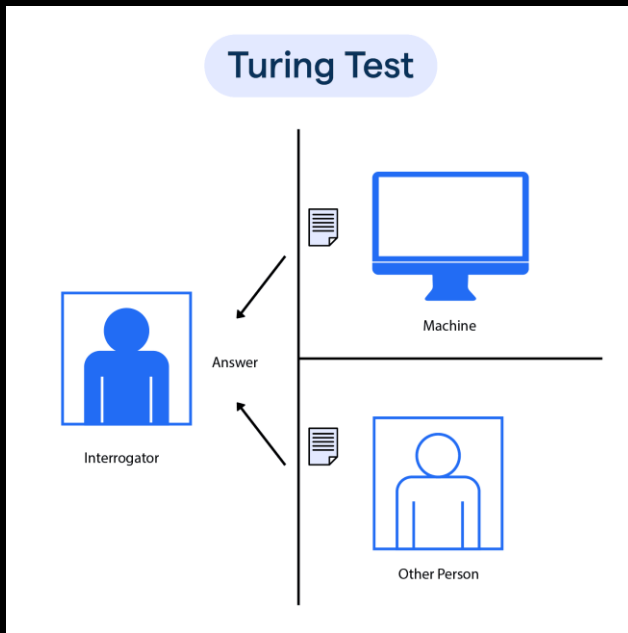


<https://www.linkedin.com/pulse/mcculloch-pitts-neuron-bidyut-bikash->

# History of AI

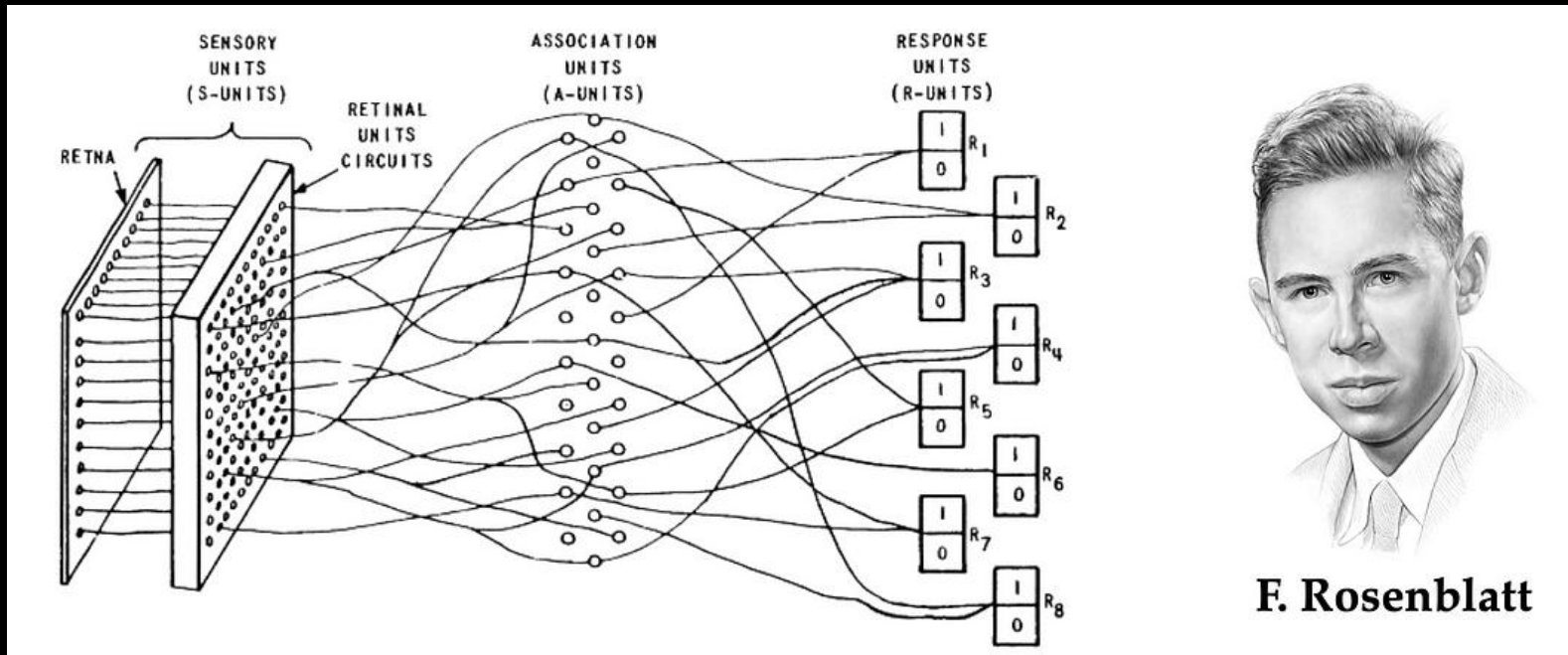
## ■ History of Artificial Intelligence (1/2)

- 1950: Alan Turing proposed the **Turing Test**, suggesting that if a conversational partner cannot be distinguished as either a human or artificial intelligence, the AI is considered to have passed the test.



## ■ History of Artificial Intelligence (1/2)

- 1957: Frank Rosenblatt introduced the **Perceptron**
- The first program that mimics the function of neural cells.

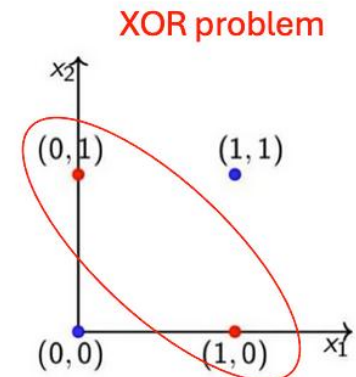
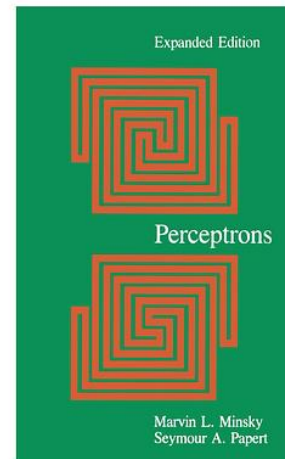


## ■ History of Artificial Intelligence (2/2)

- **1969**: Marvin Minsky and Seymour Papert pointed out the limitations of the Perceptron, stating that it could **not solve nonlinear problems such as XOR**.

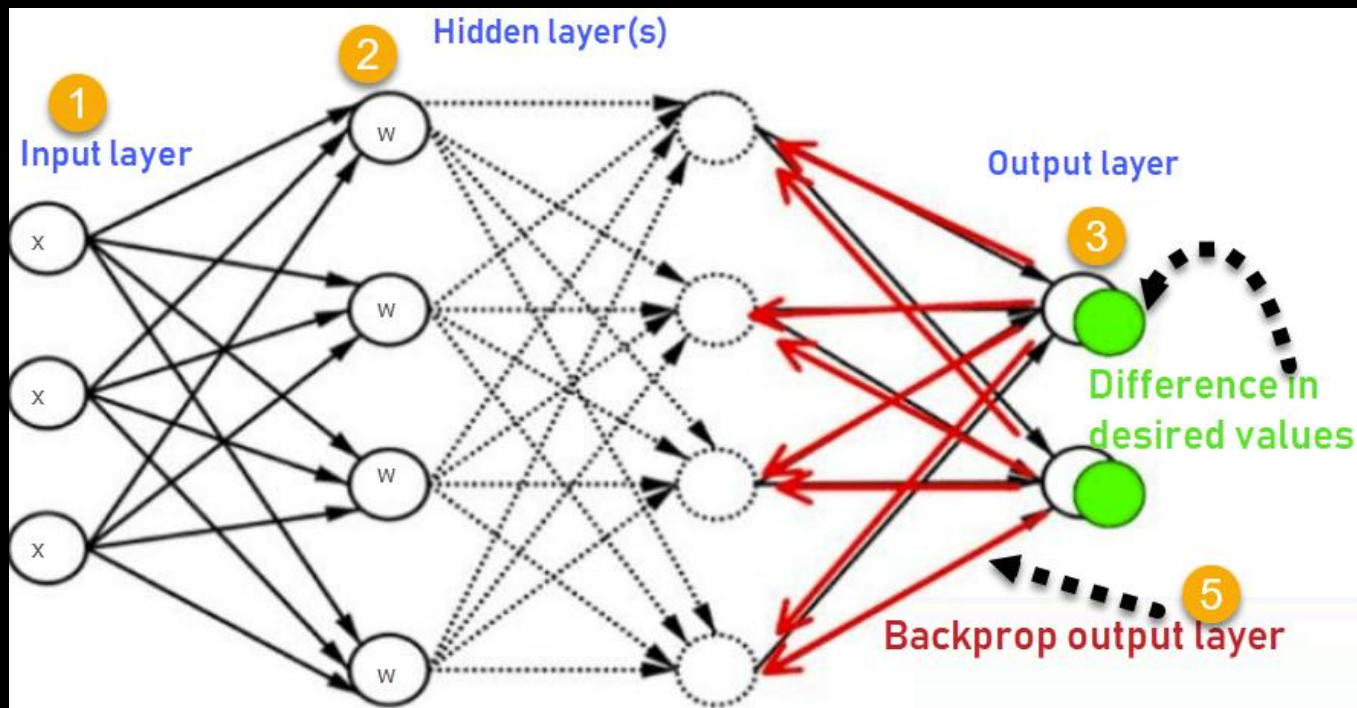


**Minsky and Papert:** Perceptrons: An introduction to computational geometry. MIT Press, 1969.



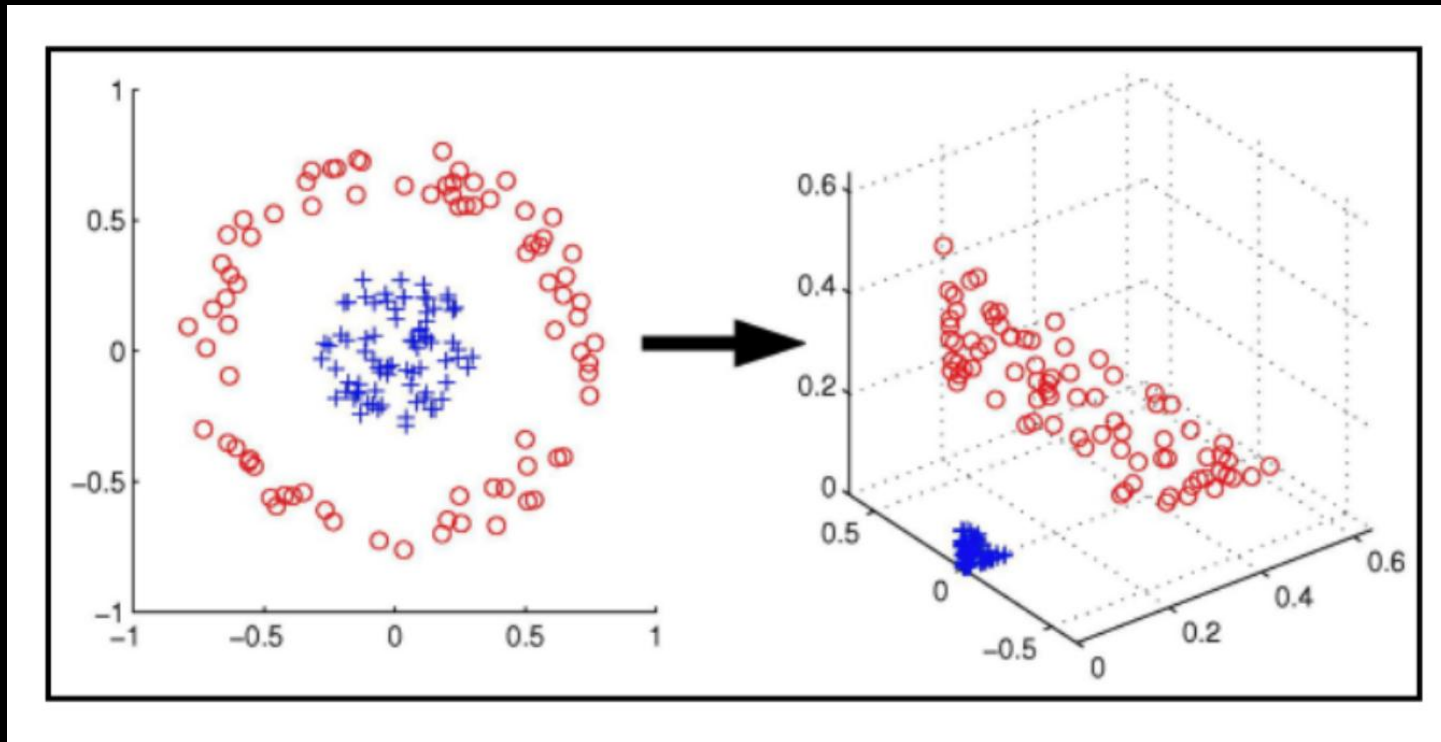
## ■ History of Artificial Intelligence (2/2)

- 1986: David Rumelhart and colleagues proposed a learning method using **error backpropagation** in multi-layer perceptrons.



## ■ History of Artificial Intelligence (2/2)

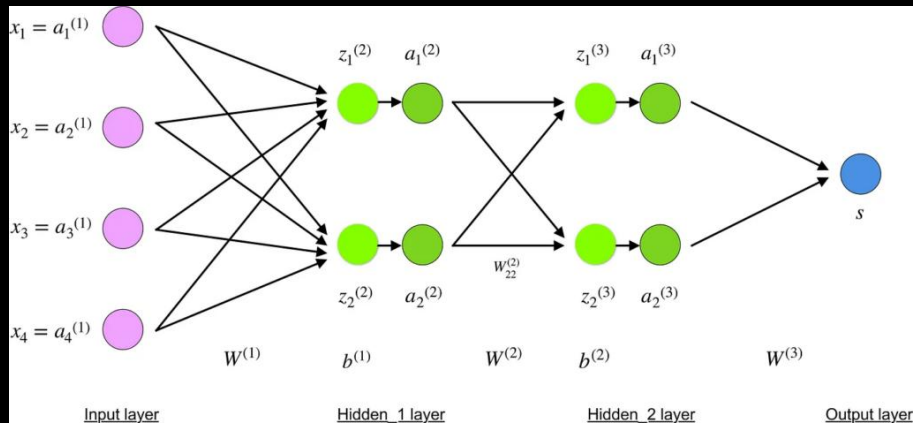
- 1995: Vladimir Vapnik and Corinna Cortes introduced the **Support Vector Machine (SVM)** model.



# History of AI

## ■ History of Artificial Intelligence (2/2)

- 2006: Geoffrey Hinton proposed **Deep Neural Networks**, marking the beginning of deep learning.



CONGRATULATIONS

**GEOFFREY HINTON**

2024 NOBEL PRIZE IN PHYSICS

- 2024: Geoffrey Hinton won Nobel Prize in Physics

# Time line of AI

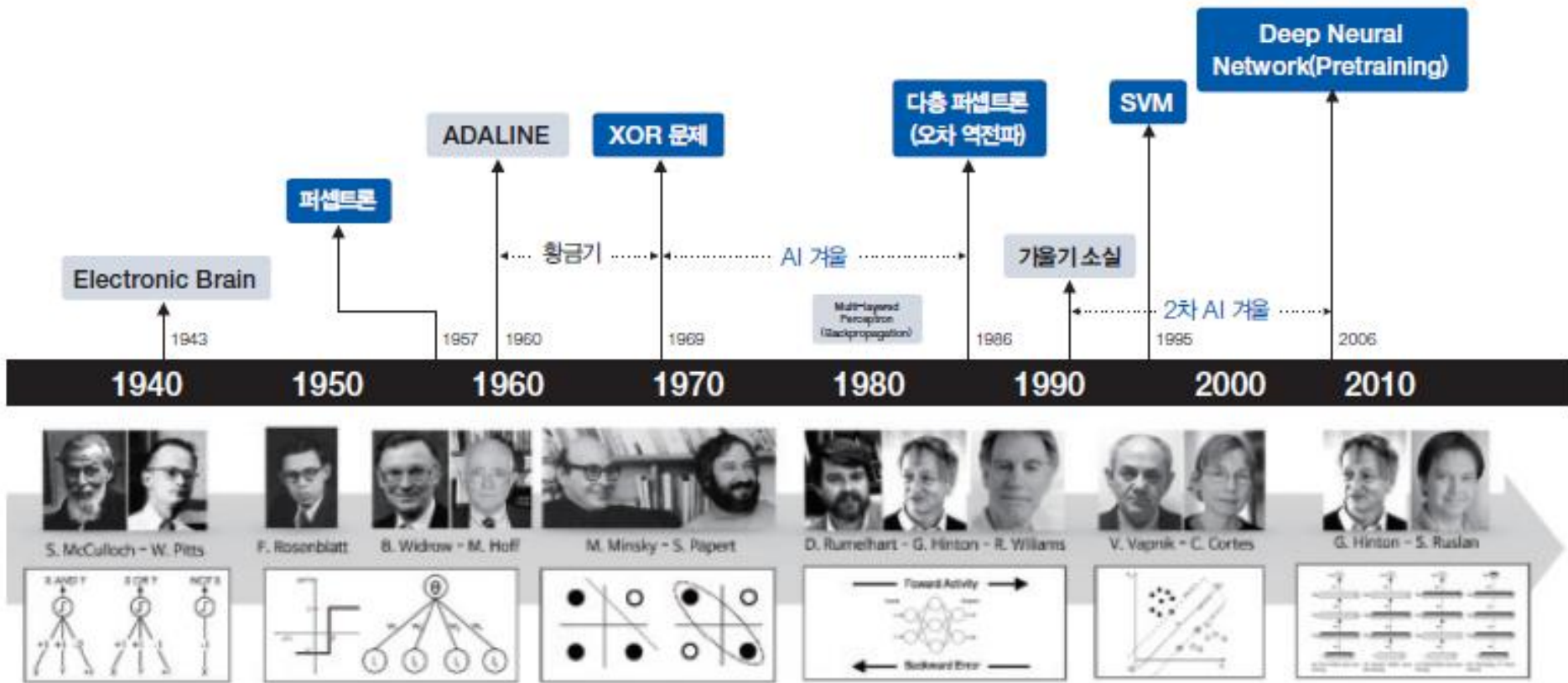


그림 1-2 인공지능의 역사 (출처: <http://hochul.net/blog/wp-content/uploads/2019/09/ABriefHistoryofAI.png>)

# Explosive Growth of AI - Data

## ■ Data

### - Structured Data

- Organized in rows and columns following a specific format.
- **Example:** Excel-style data with rows and columns.

### - Unstructured Data

- Not arranged in a predefined manner.
- **Example:** Videos, audio files, text (documents).

### - Semi-structured Data

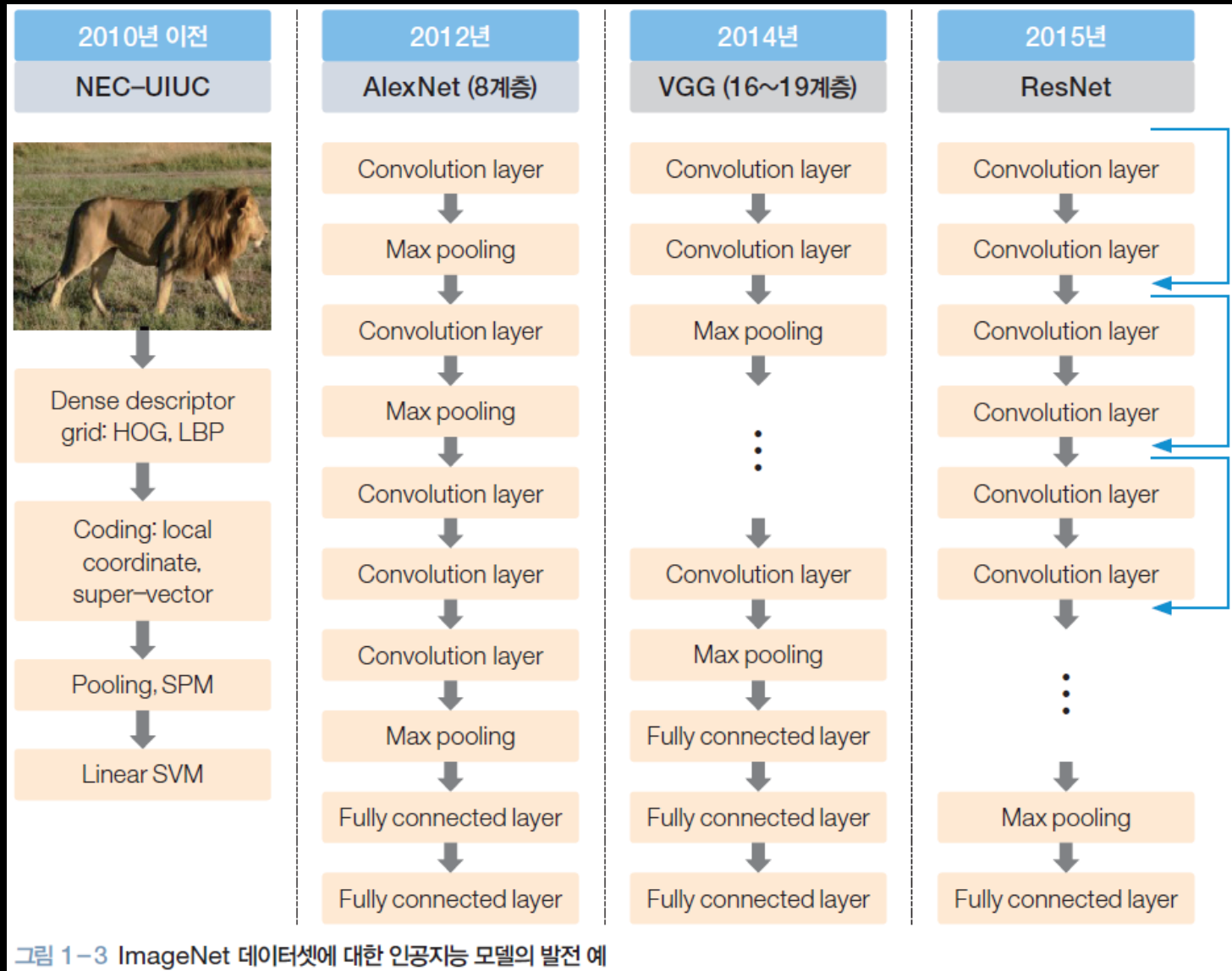
- Not stored in a structured format like relational databases but still retains some level of organization.
- **Example:** Documents stored in **JSON (JavaScript Object Notation), XML, or HTML** format.

# Explosive Growth of AI - Algorithm (1/2)

## ■ Algorithm (Model)

- Traditional Methods (Before 2010)
  - Extracted key features from images and used traditional machine learning algorithms such as Support Vector Machine (SVM) for classification.
- Introduction of Deep Learning (2012)
  - Krizhevsky et al. proposed a deep learning-based model.
  - Used the raw image as input and produced classification results directly.
- GoogLeNet (2014)
  - Utilized multiple small convolutional filters (leveraging receptive fields).
  - Introduced a deep stacking architecture with multiple layers.
- ResNet (2015)
  - Introduced the Residual Learning approach, allowing previous information to be passed to the next layer.
  - Used multiple small convolutional filters (leveraging receptive fields).
  - Reduced the number of model parameters while maintaining high performance.

# Explosive Growth of AI - Algorithm (2/2)



# Explosive Growth of AI - Computing

## ■ Computation (Computing Power)

### - Parallel Processing Capability of GPUs

- Performs multiple computations simultaneously, significantly improving learning efficiency.

### - Performance Enhancement

- Greatly increases the learning capacity of AI models, enabling the training of **large-scale models**.

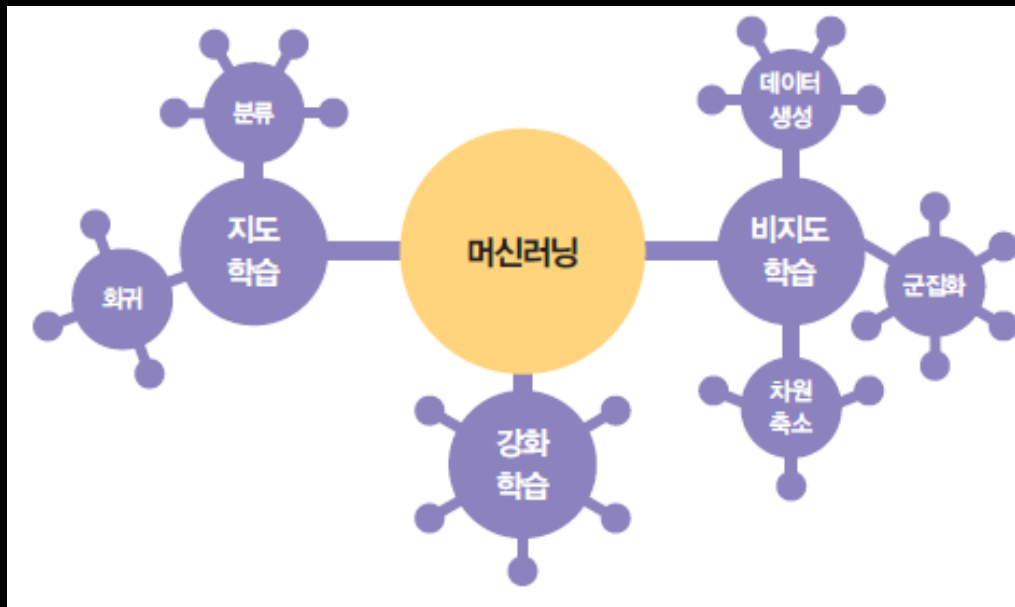
### - Development of AI-Specific Processing Units

- Continuous improvement in computational performance through AI-enabled devices such as **IoT and AI semiconductors**.

# Basics of Machine Learning

# Fundamentals of Machine Learning

- Performance improvement due to the increase in data, enhanced computing power, and improved algorithm models.
- The emergence of applications utilizing machine learning technology across various fields.



# Categories in ML

## ■ Supervised Learning

- Learns using labeled training data (with actual/true values) and then performs prediction and classification on test data.
- Common applications include **regression** and **classification**.

## ■ Unsupervised Learning

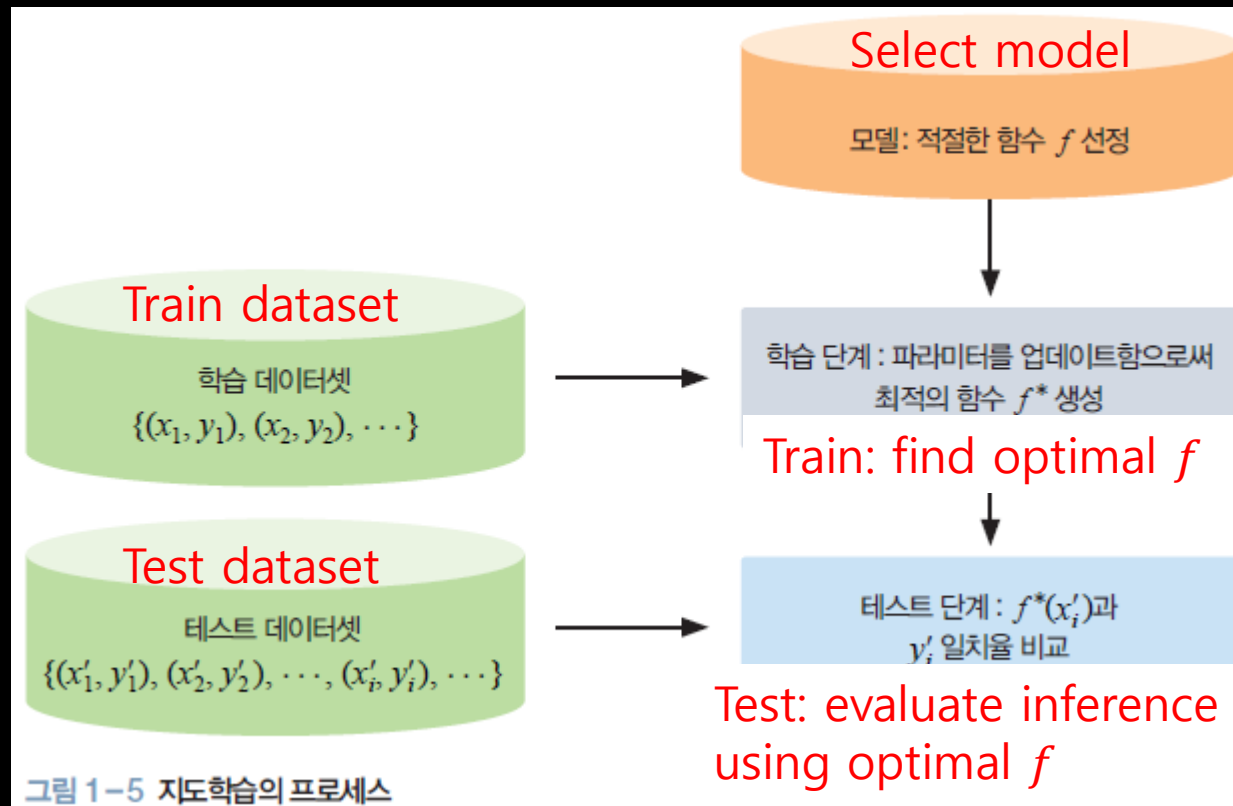
- Trains the model using **unlabeled data**, performing tasks such as **clustering**, generating new data, and dimensionality reduction.

## ■ Reinforcement Learning

- Without predefined data, an **agent** interacts with the environment, learning through trial and error to choose actions that maximize rewards.

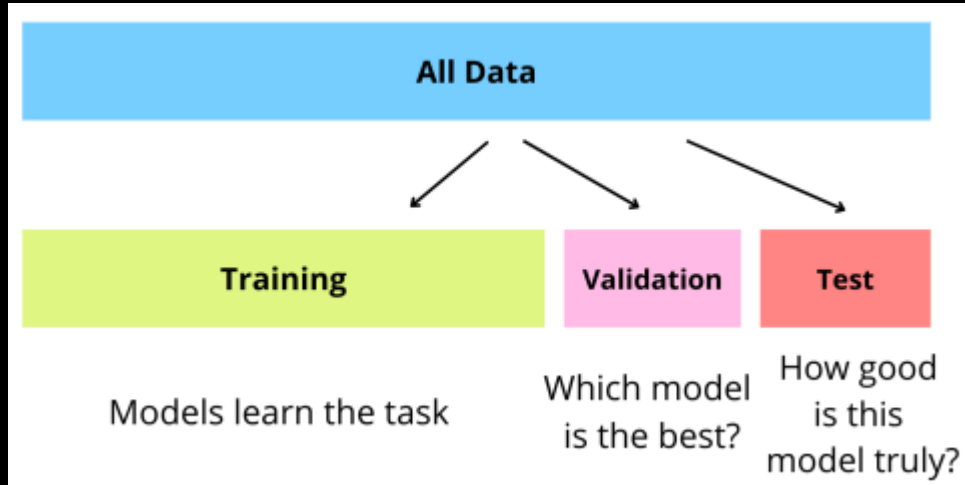
# Supervised Learning - Procedures

- **Training Phase: Generates the optimal function using observed data (Best Function)**
- **Testing Phase: Predicts the result using the learned function (Predict by Using Function).**



# Supervised Learning - Dataset

## ■ Dataset



- Composed of a Training Dataset and a Test Dataset
- Typical split ratios:
  - 7:3 or 8:2 (Training Dataset : Test Dataset).
- Validation Dataset
  - Used during training to prevent the model from overfitting to the training dataset.



수고하셨습니다 ..^^..  
Thank you!